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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte MIKA KAHOLA

Appeal 2009-002894
Application 10/033,451
Technology Center 2100

Decided: November 9, 2009

Before JOHN A. JEFFERY, ST. JOHN COURTENAY III, and JAMES R. HUGHES, *Administrative Patent Judges*.

JEFFERY, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellant appeals under 35 U.S.C. § 134(a) from the Examiner's rejection of claims 2-17. We have jurisdiction under 35 U.S.C. § 6(b). We affirm.

STATEMENT OF THE CASE

Appellant invented a link adaptation method for a wireless communication system. Specifically, packets are formed from the information to be transferred between two communication devices, and a packet error rate is defined. A modulation mode is selected from plural modulation modes using fuzzy control where the packet error rate is used as a fuzzy control variable.[1] Claim 17 is illustrative with the key disputed limitations emphasized:

17. A method for performing link adaptation in a communication system, the method comprising

forming a connection to transfer information at least partly wirelessly between two communication devices;

forming packets from the information to be transferred via the connection, said packets comprising a header and a payload;

determining a *packet error rate*; and

selecting a modulation mode for the connection from at least two different modulation modes;

wherein said *selecting a modulation mode comprises using fuzzy control;* and *using said packet error rate as one variable for said fuzzy control.*

The Examiner relies on the following as evidence of unpatentability:

Lewis	US 5,687,290	Nov. 11, 1997
Agrawal	US 6,072,990	June 6, 2000
La Porta	US 6,654,359 B1	Nov. 25, 2003 (filed Dec. 11, 1998)

[1] *See generally* Abstract; Spec. 4-6; Fig. 3b.

The Rejection

The Examiner rejected claims 2-17 under 35 U.S.C. § 103(a) as unpatentable over Agrawal, La Porta, and Lewis. Ans. 4-10.[2]

Regarding representative claim 17,[3] the Examiner finds that Agrawal discloses a link adaptation method that selects a modulation mode from multiple modulation modes by virtue of Agrawal's selection of encoding schemes. Ans. 8, 9, and 11. The Examiner also equates Agrawal's determination of word error rate with determining packet error rate as claimed. Ans. 8, 9, 15, and 16.

Based on these teachings, the Examiner finds that Agrawal discloses every recited step of claim 17 except for:

(1) forming packets from information to be transferred;

(2) selecting a modulation mode using fuzzy control; and

(3) using packet error rate as a fuzzy control variable.

The Examiner, however, relies on (1) La Porta to cure the first noted deficiency, and (2) Lewis to cure the second and third deficiencies in concluding that the claim would have been obvious. Ans. 9-10.

Appellant makes three main arguments. First, Appellant argues that Agrawal does not teach selecting a modulation mode as claimed since Agrawal's system involves "significantly different parameters" than the modulation mode selection of the claimed invention, namely transmission

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[2] Throughout this opinion, we refer to the Appeal Brief filed August 9, 2007 and the Examiner's Answer mailed November 1, 2007.

[3] Appellants argue claims 2-17 together as a group. *See* Br. 9-13. Accordingly, we select independent claim 17 as representative. *See* 37 C.F.R. § 41.37(c)(1)(vii).

power and/or error code. Appellant contrasts these parameters with those used in the claimed modulation mode selection, namely data speed, modulation method, coding rate, etc. Br. 9-10.

Second, Appellant argues that Agrawal teaches away from combining its teachings with Lewis as the Examiner proposes. According to Appellant, since Agrawal's purpose in selecting a power code pair is to limit overhead resources needed for this selection, a more flexible approach (e.g., using fuzzy logic principles as in Lewis) would not be needed, and actually runs counter to Agrawal's purpose. Br. 10.

Third, although Appellant acknowledges that it is known to form a packet with a header and a payload, Appellant argues that Agrawal's word error rate is not equivalent to packet error rate, but rather bit error rate. Br. 10-13. As such, Appellant contends, skilled artisans would not consider Agrawal's word error rate equivalent to packet error rate—a conclusion that is said to be supported by two publication abstracts in the Evidence Appendix. Br. 12-13.

The issues before us, then, are as follows:

ISSUES

1. Under § 103, has Appellant shown that the Examiner erred in rejecting claim 17 by finding that Agrawal, La Porta, and Lewis collectively teach or suggest:

(a) determining a packet error rate;

(b) selecting a modulation mode from multiple modulation modes, where the selection uses fuzzy control; and

(c) using packet error rate as a fuzzy control variable?

2. Under § 103, has Appellant shown that the Examiner erred in combining the respective teachings of Agrawal, La Porta, and Lewis to arrive at the claimed invention? This issue turns on whether Agrawal teaches away from combining its teachings with Lewis.

FINDINGS OF FACT

The record supports the following findings of fact (FF) by a preponderance of the evidence:

Agrawal

1. Agrawal's system adaptively determines an operating point for a transmitter 12 and receiver 13 that communicate via a wireless link 11. The operating point is a tradeoff between (1) the amount of control overhead used by the channel associated with the link, and (2) the resulting channel quality. Agrawal, Abstract; col. 4, ll. 18-26; col. 5, ll. 29-64; Fig. 1.

2. Transmitter 12 encodes transmitted data using a forward error correcting (FEC) encoding scheme selected from plural encoding schemes represented by $C = \{c_0, c_1, \ldots, c_n\}$ and stored in the transmitter's memory 15. Agrawal, col. 5, l. 65 – col. 6, l. 2; Fig. 1.

3. At any point during the channel's lifetime, the transmitter's operating point is defined by a set of transmission parameters, namely a power-code pair (P,c) where "P" defines the transmitter's current transmit power, and "c" identifies the current FEC encoding scheme. Agrawal, col. 6, ll. 3-8; Fig. 1.

4. Receiver 13 monitors and measures (1) the received power level; (2) the word error rate (WER); and (3) the link's interference level. At the end of each "timeframe,"[4] the receiver checks these values and, if unacceptable, sends a message to the transmitter with these values and the desired WER. Upon receipt, the transmitter uses these values to determine a new power-code pair that will be used during the next timeframe. Agrawal, col 6, ll. 9-40; Fig. 1.

5. In the Background of the Invention section, Agrawal notes that measures have been taken to maintain transmission quality over a radio channel. These measures typically try to control various channel quality metrics (e.g., error rates, carrier-to-interference ratios (CIRs), bandwidth, etc.) by controlling various channel transmission parameters (e.g., transmission power, FEC, etc.). Agrawal, col. 1, ll. 27-47.

6. Agrawal further notes that the effective bit error rate (BER) for digital transmissions depends on the modulation scheme used. To exemplify this dependence, Agrawal describes the relationship between CIR and BER for binary phase shift key (BPSK) modulation and represents this relationship mathematically in Equation (2). Agrawal, col. 1, ll. 48-60.

7. According to Agrawal, data transmission is usually packetized into words so that error granularity is at the word level. Thus, for a given BER, the observed WER depends on the type of FEC scheme used. As such, each

[4] A "timeframe" is the time period between successive iterations in which the transmitter and receiver collaborate to evaluate channel performance. The timeframe is preferably at least as long as needed to obtain reasonable estimates for the measurements. Agrawal, col. 6, ll. 18-30.

connection in a wireless system has an associated reliability constraint expressed as (1) a desired WER, and (2) a range of acceptable WERs. Agrawal, col. 1, l. 54 – col. 2, l. 12.

7A. An important factor in adaptive control of a wireless channel connection is the overhead associated with performing the control. Generally, if maintaining a required channel quality requires frequent control parameter changes for power and coding, the control approach may not be worth the result. Agrawal, col. 8, ll. 3-26.

La Porta

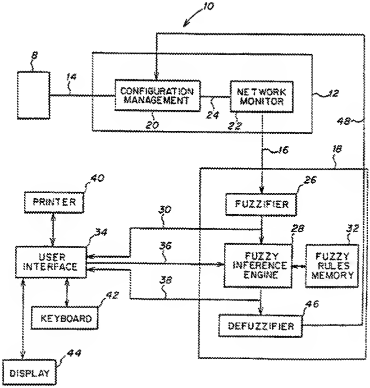
8. The Examiner's findings regarding La Porta's disclosure (Ans. 9 and 12) are undisputed. *See* Br. 10-11.

Lewis

9. Lewis discloses a system for monitoring and controlling communication networks comprising a network monitoring system 12 connected to a local area network (LAN) 8 via communications link 14. Network monitoring system 12 is also connected to a fuzzy logic control system 18 via communications link 16. Lewis, col. 4, ll. 52-60; Fig. 2.

10. Network monitoring system 12 includes (1) a configuration management module 20, and (2) a network monitor module 22. The network monitor module (a) monitors LAN 8 to detect changes in network operation parameters and control the network, and (b) transmits information concerning network operation parameters to fuzzy logic control system 18. Lewis, col. 5, ll. 20-35; Fig. 2.

11. Fuzzy logic control system 18 includes a "fuzzifier" module 26 that (1) receives values of monitored network parameters in the form of numeric data, and (2) translates this numeric data into a description language to provide fuzzy input data. This input data is then sent to a fuzzy inference engine 28 which (1) processes the data in accordance with at least one stored fuzzy rule, and (2) generates fuzzy output data that is used to control the LAN's parameters. This output data is then sent to a "defuzzifier" module 46 that (1) converts the data back into numeric data, and (2) transmits the numeric data to the configuration management module 20 to control LAN 8. Lewis, col. 5, l. 36 – col. 6, l. 4; Fig. 2. A block diagram of Lewis' network monitoring and control system is shown in Figure 2 reproduced below:



Lewis' Network Monitoring and Control System in Figure 2

12. Lewis notes that membership functions for linguistic values of variables representing network monitoring system 12 can be defined, such as packet_collision_rate, packet transmission rate, packet_deferment_rate, etc. Once the membership functions are defined, then fuzzy rules are defined that connect fuzzy input and output variables. Lewis, col. 7, l. 63 – col. 8, l. 28.

Appellant's Disclosure

13. "It is known that different packet error rates (PER) can be attained with different modulation modes in situations in which the signal to interference ratio (s/i) is constant." Spec. 2:13-16.

PRINCIPLES OF LAW

In rejecting claims under 35 U.S.C. § 103, it is incumbent upon the Examiner to establish a factual basis to support the legal conclusion of obviousness. *See In re Fine*, 837 F.2d 1071, 1073 (Fed. Cir. 1988). If the Examiner's burden is met, the burden then shifts to the Appellant to overcome the prima facie case with argument and/or evidence. Obviousness is then determined on the basis of the evidence as a whole and the relative persuasiveness of the arguments. *See In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992).

To be patentable under § 103, an improvement must be more than the predictable use of prior art elements according to their established functions. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007).

"[W]hen the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious." *Id.* at 416.

"A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant." *In re Kahn*, 441 F.3d 977, 990 (Fed. Cir. 2006) (citations and internal quotation marks omitted).

ANALYSIS

Based on the record before us, we find no error in the Examiner's obviousness rejection of representative claim 17.

First, we agree with the Examiner (Ans. 11) that Agrawal's selecting a particular encoding scheme from plural encoding schemes (FF 2) reasonably corresponds to selecting a modulation mode as claimed. As the Examiner indicates, modulation pertains to how data is coded to send it through a transmission medium (Ans. 11)—a technique that reasonably comports with Agrawal's FEC encoding scheme that the transmitter uses to encode data sent to the receiver via a channel associated with a wireless link. *See* FF 1-3.

Even assuming that Agrawal uses different parameters in this selection as compared to the invention as Appellants argue (Br. 10), claim 17 does not require the particular parameters that Appellant indicates distinguish the invention from Agrawal. All the claim requires in this regard is that a modulation mode be selected from multiple modulation modes—a limitation whose scope does not preclude Agrawal's selecting an encoding scheme that is based on transmission parameters to determine an appropriate

operating point. *See* FF 3-4. We therefore agree with the Examiner that Agrawal's selecting a particular encoding scheme from plural encoding schemes (FF 2) reasonably corresponds to selecting a modulation mode as claimed.

To be sure, Agrawal's receiver monitors and measures the *word* error rate (WER) that the transmitter then uses as a basis to determine a new power-code pair (FF 4). As such, Agrawal does not explicitly state that the *packet* error rate is used in this process. *See id.* Nevertheless, we agree with the Examiner (Ans. 15-16) that Agrawal's WER determination at least suggests a packet error rate determination.

Although Agrawal represents an error rate for BPSK modulation in terms of *bit* error rate (BER) and CIR in the Background section (FF 6), Agrawal nevertheless indicates that data transmission is usually *packetized into words* so that error granularity is at the word level (FF 7; emphasis added). Thus, for a given BER, the observed WER depends on the type of FEC scheme used. *Id.*

Agrawal's word choice here is telling: the term "packetized" all but indicates that the words are associated with some form of data packet. *See id.* Indeed, as blocks of data, the words themselves could be reasonably construed as "packets" given the import of this passage. *See id.*

Therefore, skilled artisans would have reasonably inferred from Agrawal that an error rate associated with words (e.g., WER) would at least be associated with an error rate associated with corresponding packets (i.e., a "packet error rate"). Notably, Appellant does not define the term "packet

error rate" in the Specification and, as such, Agrawal's WER reasonably corresponds to a "packet error rate" under the term's broadest reasonable interpretation. The Examiner's point in this regard (Ans. 16) is well taken.

Appellant relies heavily on Agrawal's expressing WER in terms of BER to support the contention that Agrawal's WER is equivalent to BER—not packet error rate. Br. 11-13. Appellant also cites two publication abstracts in the Brief's Evidence Appendix that are said to support the proposition that packet error rate is not equivalent to WER or BER. Br. 12-13; Ev. App'x.

These arguments are unavailing. First, as we indicated previously, nothing in claim 17 precludes Agrawal's WER from corresponding to a "packet error rate" under the term's broadest reasonable interpretation. As such, even assuming that Agrawal's WER can be expressed in terms of BER (*see* FF 6-7), this WER nonetheless fully meets a "packet error rate" given the scope and breadth of the term.

Second, even if we assume, for the sake of argument, that Agrawal's WER somehow does not meet a "packet error rate" as claimed, the fact that Agrawal's WER is described in connection with an associated BER (*see id.*) is hardly dispositive of whether it would also have an associated packet error rate.

In this regard, the cited abstracts in the Evidence Appendix are not persuasive. Although the first abstract ("Abstract 1") concludes that BER is not a good indicator of packet error (and vice-versa) based on comparative test results (Br. 21; Ev. App'x), this conclusion hardly means that determining a packet error rate would not have been an obvious improvement over determining BER or WER in Agrawal.

We reach a similar conclusion regarding the second abstract ("Abstract 2") which indicates that the analysis of BER with respect to a wireless network's mean behavior is insufficient in packet error rate evaluations (Br. 21-22; Ev. App'x). Here again, the fact that BER may be insufficient in packet error rate evaluations hardly means that determining packet error rate is a nonobvious improvement over determining WER or BER in Agrawal. If anything, the articles tend to suggest the opposite since they readily acknowledge that packet error rate—like BER—is a well-known metric in evaluating data transmission. That Appellant indicates in the Specification that it is known to obtain packet error rates (FF 13) only bolsters this conclusion.

In any event, we find that determining packet error rate in lieu of WER or BER in Agrawal is tantamount to the predictable use of prior art elements according to their established functions—an obvious improvement. *See KSR*, 550 U.S. at 417. Moreover, Appellant has provided no evidence on this record establishing that determining packet error rate in lieu of WER or BER in Agrawal would have been an improvement beyond the level of skilled artisans. *See id.* ("[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.").

Nor are we persuaded that the Examiner erred in combining the teachings of La Porta and Lewis with Agrawal to arrive at the claimed invention. Notably, the Examiner's findings regarding La Porta's disclosure pertaining to forming packets are undisputed (FF 8). Indeed, Appellant admits that forming packets with a header and payload for routing is well

known. Br. 11. As such, we see no reason why this teaching could not be applied to Agrawal's data transmission system to form packets with a header and a payload from the information to be transferred.

We also find no error in the Examiner's combining Lewis' teachings of a fuzzy control system with Agrawal. Significantly, Lewis' fuzzy logic control system operates in conjunction with a network monitoring system to perform network monitoring and control functions in accordance with fuzzy control principles (i.e., using fuzzy rules and fuzzy data processing techniques). FF 9-12. Notably, membership functions for linguistic values of variables representing the network monitoring system associated with Lewis' fuzzy control system can be defined in terms of packet characteristics and errors (e.g., packet collision rate). FF 12. Lewis therefore at least suggests using packet error rate as a fuzzy control variable.

Based on these teachings, we see no reason why Agrawal's modulation mode selection could not utilize a fuzzy control system such as that disclosed by Lewis, particularly since both references pertain to monitoring and controlling parameters associated with a data communications system. *Compare* FF 1-4 *with* FF 9-11. Such an enhancement is tantamount to the predictable use of prior art elements according to their established functions—an obvious improvement. *See KSR*, 550 U.S. at 417.

Nor does Agrawal teach away from such an approach. To be sure, Agrawal does indicate that overhead is an important factor in adaptive control, and that frequent control parameter changes can be detrimental and not worth the result. FF 7A. As such, limiting overhead would be an important consideration in Agrawal's system as Appellant argues (Br. 10).

But ultimately, the operating point in Agrawal is a *tradeoff* between (1) the amount of control overhead used by the channel associated with the link, and (2) the resulting channel quality. FF 1. Therefore, even assuming, without deciding, that using a fuzzy logic control system such as that disclosed by Lewis in Agrawal's system increases control overhead (a finding that has not been made on this record in any event), such a drawback could very well be offset by the advantages in channel quality obtained via a fuzzy control system. Such an engineering decision would be well within the level of ordinarily skilled artisans.

As such, skilled artisans would not be discouraged from following the path set out in Agrawal and Lewis, nor would they be led in a direction divergent from the path that was taken by Appellant. *See Kahn*, 441 F.3d at 990. Accordingly, we do not find that Agrawal teaches away from its combination with Lewis to arrive at the claimed invention as the Examiner proposes.

For the foregoing reasons, Appellant has not persuaded us of error in the Examiner's rejection of representative claim 17. Therefore, we will sustain the Examiner's rejection of that claim, and claims 2-16 which fall with claim 17.

CONCLUSION

Appellant has not shown that the Examiner erred in rejecting claims 2-17 under § 103.

ORDER

The Examiner's decision rejecting claims 2-17 is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

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